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FIRE PROTECTION of VESSELS DURING CONSTRUCTION, REPAIR & LAY-UP

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National Fire Protection Association

INTERNATIONAL

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of the public in establishing proper safeguards against loss of life and property by fire.

General Committee on Marine Fire Protection.

THOMAS M. TORREY,* *Chairman,*
Insurance Co. of North America, 99 John St., New York 7.

CHARLES S. MORGAN,† *Secretary,*
National Fire Protection Assn., 60 Batterymarch St., Boston 10.

L. K. BERMAN,
National Automatic Sprinkler & Fire Control Assn.

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National Assn. of Engine & Boat Mfrs.

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Pacific Maritime Assn.

BILLINGS WILSON,
American Assn. of Port Authorities.

F. T. WRIGHT,
Underwriters' Laboratories, Inc.

Committee on Shipbuilding, Repair and Lay-Up.

L. R. SANFORD, *Chairman,*
Shipbuilders Council of America, 21 West St., New York 6.

E. W. COSTELLO,*
Todd Shipyards Corp.

GEORGE W. DAWSON,*
Vlachos & Co.

JESSE C. JONES,
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C. H. LUNDEGAARD,
U. S. Maritime Administration.

B. L. ROGERS,*
Maryland Dry Dock Co.

ELMER T. SCHNEIDER,*
Bethlehem Steel Co.

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*Serving in a personal capacity in accordance with Par. 11-b-2 of the Regulations on Technical Committee Procedure.

†Non-voting member.

Recommendations for Fire Protection of Vessels During Construction, Repair, and Lay-Up.

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Recommendations for
FIRE PROTECTION OF VESSELS
DURING CONSTRUCTION, REPAIR, AND LAY-UP.

FOREWORD.

The first standard on this subject was adopted tentatively by the NFPA in 1933 on recommendation of the Marine Committee, predecessor of the Marine Section. It was further considered in 1935, 1936, and 1937 and was finally adopted in 1938 on recommendation of the Marine Section Committee on Builders' Risk, Repair and Lay-Up. That edition was reprinted in 1942 with editorial changes. With the reorganization of NFPA marine activities in 1948, the Committee on Shipbuilding, Repair and Lay-Up was established. This committee prepared the following recommendations, which supersede the 1942 edition. These were endorsed by the General Committee on Marine Fire Protection and adopted by the Association; Parts 1 and II at the 1950 annual meeting, Part III in 1951.

INTRODUCTION.

Owing to the quantity and character of combustible materials used in the construction of many vessels, such vessels in course of construction and during repair are readily vulnerable to fire. Long alleyways, unenclosed stairways, hatches and hoistways facilitate the rapid spread of fire throughout the vessel. The location of the shipyard is frequently so isolated that dependence for fire fighting is mainly on the private protection provided. Even where major municipal protection is available, the possible delayed response due either to lateness in the discovery of the fire or the absence of means for quick notification, lack of special equipment in many municipal fire departments for combating shipboard fires, or an unfamiliarity with ship construction due to the transitory nature of the risk may cause material damage or complete destruction before effective means of extinguishment can be brought into action. It is, therefore, obvious that every reasonable means of preventing fire should be provided and supplemented by such means of detection and protection equipment as will permit the prompt discovery, retard the spread, and permit extinguishment of any fire before it has passed the incipient stage. To this end the adoption of the following recommended safeguards is urged.

PART I.

VESSELS IN COURSE OF CONSTRUCTION.

1. General Care and Cleanliness.

(a) Vessels, shipways and outfitting piers should be kept as clean as conditions will permit. All accumulations, and particularly combustible rubbish, refuse and waste materials, should be collected and safely disposed of promptly and at least daily as the work progresses. Areas in which hazardous work is to be done should be in a clean condition before such work is started.

(b) Furniture and other equipment usually crated or packed in excelsior or similar packing materials should be uncrated or removed from packing in a safe location, preferably well removed from vessels. All packing materials should be disposed of promptly and safely.

(c) Temporary protective coverings such as tarpaulins which may be used to protect machinery, equipment, combustible stores or similar materials should either be of non-combustible material or properly flame-proofed.

(d) Smoking should be prohibited except in locations specifically designated as smoking areas and approved by management or authority having jurisdiction.

2. Storage of Explosive and Flammable Materials.

The storage of explosive, highly flammable or combustible materials should not be permitted on vessels in course of construction, nor in close proximity to the ways and outfitting berths. This should not be construed to prevent the storage of such quantities as may be necessary for the normal progress of the work, provided such storage is arranged so as not to obstruct fire-fighting operations.

3. Use of Open Flame or Spark Emitting Devices.

(a) Before any hot work requiring the use of riveting, welding, burning, heating or other fire or spark producing operations is started, it should be the responsibility of the superintendent or his designated assistants to determine that such work may proceed with safety. Special attention is called to the danger of hot work in freshly painted areas, in refrigerated spaces, in close proximity to combustible stores or other materials and similar locations. Steps should be taken to assure that all open fires are secured during meal times and that all fires are extinguished at the close of the work period.

(b) It is particularly important that employees check the opposite sides of bulkheads or decks on which hot work is to be done, to be certain that there are no combustible materials, painted surfaces, wiring runways, etc., in contact with or in close proximity to such bulkheads or decks which may be damaged by heat or fire.

(c) Hot work in bunkers or other fuel spaces containing flammable or combustible liquids or vapors, involving riveting, welding, burning, heating or other fire or spark producing operations, should be done only after certification in accordance with the NFPA *"Standards for the Control of Gas Hazards on Vessels to be Repaired"* (NFPA No. 306).

(d) Heating for the personal comfort of employees or for other reasons should be done by means of steam, hot water, or electricity using the vessel's heating facilities so far as practicable. Where salamanders are used they should be of an approved type, burning coal or coke only, and should be

permitted only where someone is constantly in attendance. They should be located a safe distance from combustible materials and so arranged as to avoid any danger of upset. Under no conditions should compressed air or oxygen be discharged into salamanders to increase the rate of burning. Attention is called to the need for adequate ventilation in confined spaces where salamanders are used.

(e) Equipment such as blow torches, cutting and welding apparatus should be so stored at the close of each day's work as to prevent tampering by unauthorized persons. Oxygen, acetylene and other flammable gas lines should be disconnected at the source of supply at the end of each working shift, and the discharge end of the hose removed from below decks or enclosed spaces. Electrode holders should be so placed that arcing or short circuits will not take place in case a control switch is accidentally closed.

(f) Where there is any danger of starting fires in way of hot work, despite the fact that other ordinary precautions are employed, a fire watch should be provided to stand by during such operations with portable fire-fighting equipment ready to extinguish any incipient fire that may occur.

4. Application of Paints and Other Flammable Compounds.

No welding, burning, or other open flames or spark-producing machines or operations such as chipping, grinding, etc., should be permitted in close proximity to the application of flammable paints or other flammable compounds. Adequate ventilation should be provided in such areas as deemed necessary to maintain the atmosphere below the lower explosive limit or below the lower limit of toxicity as specified in Table I. of the *Standards for the Control of Gas Hazards on Vessels to be Repaired.* (See page 12.) Where artificial lighting is needed in hazardous areas, only approved explosion-proof lights should be used.

5. Temporary Electrical Installations.

Electrical wiring and equipment of a temporary nature should be substantially installed in such manner as to be safe from physical damage, and should be inspected frequently. Defects in wiring, fixtures or equipment of a type liable to create dangerous conditions should be promptly remedied. Portable equipment should be properly fused and should be disconnected when not in use. Except where lights are required for inspection purposes, electric current to the vessel's lighting system should be cut off when no work is being done. Electric welding lines should be kept triced up off the decks wherever practicable.

6. Protection to Door Openings.

(a) As construction progresses, so far as practicable, all door openings should be provided with their permanent doors.

(b) In order to minimize the spread of fire, it is essential that all doors, including draft stop doors, fire screen doors and watertight bulkhead doors, be kept closed when work is not in progress. So far as practicable, care should be taken that the closing of these openings is not obstructed or prevented by hose and pipe lines, electric connections or other lines. Provisions for disconnecting such lines should not be considered as a satisfactory alternative. All other openings through bulkheads such as vent ducts should be kept closed off during the course of construction, wherever practicable.

(c) Where doors to quarters are kept locked to prevent theft or unauthorized entry, the keys should be made available to the watchman and

fire brigade, or should be located at a designated place aboard where they can be obtained without delay in emergencies by such personnel.

7. Staging.

Staging other than steel or fire retardant treated wood should be removed as soon as its purpose has been served. It is recommended that combustible stocks be whitewashed or coated with other flame-retardant compounds to resist ignition from sparks and to retard the spread of fire. Small buildings or similar structures on or under shipways should be restricted to those absolutely necessary, and should be of non-combustible construction.

8. Watch Service.

(a) During outfitting, it is recommended that there be installed on the vessel an approved watchmen's supervisory system of watch boxes connected to a central office where watchmen's signals will be received.

(b) Where watch systems such as described in (a) are not feasible or are not deemed necessary, an approved watchman's portable clock system should be provided during the outfitting period.

(c) Such watch service may also be necessary on the shipways during earlier stages of construction depending upon the degree of completion of vessels, combustibility of ways, stocks and staging, and the obstruction or congestion caused by the proximity of adjacent ways.

(d) Before going on duty, watchmen should be informed of locations where riveting, welding, burning or other hot work has been carried on in the vicinity of combustible material during the previous work period. They should also be advised of the locations of freshly painted areas, tanks containing oil, or other hazardous conditions. All such locations should be inspected during the progress of the work and as soon as practicable after work has been stopped. The regular watch force should be assisted by other competent persons when necessary in order to complete the inspection within a reasonable period. The watchmen should be required to give further special attention to these locations during their rounds so as to ensure against the spread of any previously undetected fires.

(e) Watchmen should be familiar with the location of all items of fire equipment on vessels, and should inspect them during their daily tours of inspection.

(f) Careful selection of watchmen is emphasized. Alertness, quick mental reaction, perfect hearing and sense of smell, good eyesight, bodily agility and good health are indispensable requirements for a competent watchman.

9. Fire Alarm Service.

At yards where private fire alarm systems are provided, temporary private fire alarm boxes should be installed on or near vessels under construction. Where private fire alarm or central station supervised watchman's system are not provided, telephones should be made available at convenient locations on or near vessels and connected to a central office where someone is constantly on duty, who is charged with the responsibility of and provided with suitable means for promptly summoning public or private fire-fighting facilities.

10. Fire Protection Equipment.

(a) Water for fire extinguishing purposes should be available to all parts of vessels under construction. Approved 1½ in. and 2½ in. hose lines

of adequate length connected to shore hydrants or hose connections should lead to points on vessels convenient for use in an emergency. Adequate supplies of spare hose and nozzles should be readily available.

(b) During the construction of large vessels, it is recommended that temporary pipe risers with hose connections be installed at the shipways and that a supply of hose be available at such connections on the various decks of vessels under construction. These risers should be installed in the ratio of one for each 200 feet of length of the vessel. For vessels at outfitting piers, hose lines should be provided in this same ratio.

(c) Where automatic sprinklers are installed as part of a vessel's permanent fire equipment, they should be progressively placed in service as they are installed.

(d) There should be provided at convenient locations throughout vessels, approved portable fire-fighting and extinguishing appliances such as hand extinguishers in suitable numbers, and emergency breathing apparatus. The location of such equipment should be suitably designated. This may be done effectively by red lights, continuously lighted when electric current is in service on vessels.

(e) Equipment should be available for extinguishing Class B and C fires* which cannot be controlled by portable hand extinguishers.

11. Fire Brigade.

Except where a private fire department with paid members is separately employed, designated employees should form the nucleus of a fire brigade, and should be thoroughly drilled in the use of the extinguishing equipment provided, including the laying of hose lines, the handling of hose streams and special extinguishing equipment, and the use of self-contained breathing apparatus. Drills should be held at least once a month.

12. Mooring at Outfitting Piers.

(a) When vessels are at outfitting piers it is recommended that all openings below weather decks not in use for access or ventilation be kept closed as far as practicable. Where more than one vessel is at the same pier or in the same wet basin, provision should be made for the withdrawal of any vessel in the event that fire may make such withdrawal necessary.

(b) On vessels afloat, all practicable and reasonable measures should be taken to insure maximum stability. After an outbreak of fire, at the first indication of lack of stability, the discharge of fire streams should be reduced to the minimum necessary to prevent the spread of fire. Effective means to prevent overturning of the vessel should be undertaken as soon as the extent of the fire indicates there will be danger of lack of stability.

PART II.

VESSELS UNDER REPAIR.

20. Vessels enter repair yards in various conditions, the nature of which cannot be determined until an inspection has been made. This should be done by a responsible and qualified employee as soon as practicable after vessels enter a yard, and in any case before repair work is started. Such

*Class "B" Fires may be defined as fires in flammable liquids, greases, etc., where a *blanketing* effect is essential.

Class "C" Fires may be defined as fires in electrical equipment, where the use of a *non-Conducting* extinguishing agent is of first importance.

inspection should note housekeeping conditions, including location of dunnage and trash; the kind and amount of cargo aboard; and the type, amount and condition of the vessel's fire equipment. With the assistance of a ship's officer, determination should be made of the kinds and amounts of fuel oils or other flammable liquids in all cargo, bunker, deep, settler, and double bottom tanks. On all vessels and especially passenger vessels, the location and amount of combustibles such as dry stores, provisions, concentrations of mattresses and other bedding, life preservers, etc., should be determined. The information obtained should be distributed to the departments responsible for the fire safety of vessels while in the yard, and to the various production departments which are to make repairs to the vessels.

21. General Care and Cleanliness.

(a) All combustible materials, dunnage and trash in way of hazardous repair work should be moved to a safe location, or preferably, removed from the vessels.

(b) Where practicable, all combustible stores in way of hazardous repair work should be moved to a safe location aboard or ashore.

(c) Temporary protective coverings such as tarpaulins, which may be used to protect machinery, equipment, combustible stores or similar materials should either be of non-combustible material or properly flameproofed.

(d) Wherever practicable, all oil and other flammable liquids should be removed from vessels while in repair yards.

(e) Only non-sparking tools should be used in opening piping, pumps, valves, etc., carrying flammable liquids or gases.

(f) Smoking should be prohibited except in locations specifically designated as smoking areas and approved by management or authority having jurisdiction.

22. Storage of Explosives or Other Dangerous Cargo.

Vessels carrying explosives or other dangerous cargo, excepting standard ships' stores, should not be permitted to enter a repair yard until such materials have been removed.

23. Riveting, Welding and Other Hot Work.

(a) Electric welding cables should be inspected frequently and cables with damaged insulation should be reinsulated or replaced. Cables should be triced up off steel decks, bulkheads, etc., wherever possible to reduce the possibility of short-circuiting or grounding. Electrode holders, when not in actual use, should be so placed that they will not result in arcing or electrical short circuits.

(b) Only oxygen, acetylene or other flammable gas hose in good repair should be used. Where gases are supplied from portable cylinders, the latter should not be placed below the main deck, in confined spaces, or under overhanging decks. Oxygen, acetylene and other flammable gas lines should be disconnected at the source of supply at the end of each working shift, and the discharge end of the hose removed from below decks or confined spaces.

(c) Before any hot work involving riveting, welding, burning, heating or other fire or spark producing operations is started in or on any fuel spaces or other areas which contain or have contained flammable or combustible liquids or vapors, certification of such areas should be obtained in accord

ance with the NFPA *Standards for the Control of Gas Hazards on Vessels to be Repaired* (NFPA No. 306). Attention is called to the hazards of gasoline in the tanks of motor-driven life boats.

(d) Prior to the start of any welding or burning operations, employees should ascertain that conditions in the area are safe to proceed with such operations. On refrigerated ships it may be necessary to remove combustible insulation for a safe distance from the location where welding or burning is to be done, and special care must be taken to prevent sparks or hot slag from entering exposed insulated spaces. Equipment and materials in way of hot work which cannot be moved should be protected as prescribed in Article 21(c). Doorways, hatch and tank openings, portholes, etc., should be protected where there is danger of sparks or hot slag dropping or ricocheting into such openings and igniting combustible materials. Hot work should not be done on vessels where there is danger of sparks or hot slag falling into any oil slicks on the waters beneath.

(e) It is particularly important that employees check the opposite sides of bulkheads or decks on which hot work is to be done, to be certain that there are no combustible materials, painted surfaces, wiring runways, etc., in contact with or in close proximity to such bulkheads or decks which may be damaged by heat or fire.

(f) Riveting furnaces should be located with due regard for the safety of any combustible materials nearby. All fires in rivet heating furnaces or pots should be extinguished at the close of each shift. Attention is called to the need for adequate ventilation in confined spaces where riveting furnaces are used.

(g) Where hot work processes cannot be properly safeguarded in making necessary repairs, such repairs should be accomplished by safer means, such as by drilling, sawing, bolting, or other appropriate means.

24. Heating.

Heating for the personal comfort of employees or for other reasons should be done by means of steam, hot water, or electricity, using the vessel's heating facilities so far as practicable. Where salamanders are used they should be of an approved type, burning coal or coke only, and should be permitted only where someone is constantly in attendance. They should be located a safe distance from combustible materials and so arranged as to avoid any danger of upset. Under no conditions should compressed air or oxygen be discharged into salamanders to increase the rate of burning. Attention is called to the need for adequate ventilation in confined spaces where salamanders are used.

25. Application of Paints and Other Flammable Compounds.

No welding, burning or other open flames or spark-producing machines or operations such as chipping, grinding, etc., should be permitted in close proximity to the application of flammable paints or other flammable compounds. Adequate ventilation should be provided in such areas as deemed necessary to maintain the atmosphere below the lower explosive limit or below the lower limit of toxicity as specified in Table I. of the *Standards for Control of Gas Hazards on Vessels to be Repaired.* (See page 12.) Where artificial lighting is needed in hazardous areas, only approved explosion-proof equipment should be used.

26. Watch and Fire Alarm Service.

(a) On inactive vessels berthed at repair yards with few or no crew members aboard, and on all major conversions and major repair operations, temporary watch service should be provided.

(b) At yards equipped with private fire alarm systems, it is desirable to install one or more temporary fire alarm boxes on or near the vessels. The fire alarm boxes on piers and in the yards should be plainly marked so as to be easily located. Where fire alarm systems are not provided, telephone service should be conveniently located on or near each vessel.

27. Fire Protection Equipment.

(a) While vessels are at piers or in dry dock, it is recommended that temporary hose lines supplied by shore connections be placed aboard vessels connected and ready for use, in the ratio of at least one hose line for each 200 feet of length of vessel. Where this may be deemed unnecessary due to the size and type of vessel involved, hose lines should be provided at the piers or dry docks. These lines should be nominal 1½-in. or 2½-in. in size, or a combination of both sizes, and of sufficient length so that any part of the vessel may be reached by at least one line.

(b) It is recommended that the vessel's fire system piping be connected to water supplies from the yard by means of temporary shore to ship connections. Caution should be used in turning on these water supplies at shore connections until it is determined that the vessel's fire system piping is intact and will not result in flooding any portion of the vessel.

(c) It is recommended that in addition to the vessel's facilities at least two units of first-aid fire protection (portable extinguishers) suitable for Class "B" fires be placed aboard. Additional units for Class "A," "B" and "C" fires (see Note below) may be required aboard depending upon such factors as the location, nature and extent of the repair or conversion work and the construction of the vessel. Hose lines (¾ in. size) supplied from shore connections, provide very satisfactory first aid protection for Class "A" fires.

(d) It is recommended that temporary, appropriately worded, danger markings or warning signs be posted throughout vessels where required, while vessels are in a repair yard. Sample wordings of such signs are: Smoking Prohibited—Danger Fuel Oil—Paint Storage Positively No Hot Work—Cork Insulation No Welding or Burning—Carbon Dioxide Do Not Enter.

Note:

Unit of First-Aid Fire Protection.

Underwriters' Laboratories, Inc., has established a unit for convenience in measuring the fire protection afforded by portable fire extinguishing appliances.

The unit is composed of from one to five hand portable fire extinguishing appliances, depending upon the extinguishing value of the kind and size of appliances comprising the unit. The number of extinguishers of each kind and size necessary to comprise one unit of fire protection is indicated on the label of Underwriters' Laboratories affixed to each approved extinguisher.

Classification of First Aid Fire Appliances.

In order to express the relative values of First Aid Fire Appliances, the following classification plan has been established:

Classification of Fires: For all practical purposes there are three general classes of fires:

Class "A" Fires may be defined as fires in ordinary combustible materials where the Quenching and cooling effects of quantities of water, or solutions containing large percentages of water, is of first importance.

Class "B" Fires may be defined as fires in flammable liquids, greases, etc., where a Blanketing effect is essential.

Class "C" Fires may be defined as fires in electrical equipment, where the use of a Non-conducting extinguishing agent is of first importance.

(e) Where there is any danger of starting fires in way of hot work, despite the fact that other ordinary precautions are employed, a fire watch should be provided to stand by during such operations with portable fire fighting equipment readily at hand to extinguish any incipient fire that may occur.

28. Temporary Electrical Installations.

(a) The vessels' lighting system should be used insofar as practical, except as prohibited in Paragraph 25, supplied either by self-generated power or from shore to ship connections.

(b) Where temporary portable electric lights must be used, they should be made up with substantial rubber-covered wire, and with substantial metal guards over lights. Where temporary artificial lighting is needed in hazardous areas, only approved explosion-proof lighting fixtures should be used.

(c) Temporary electrical wiring should be installed in a safe manner and should be properly fused. Such wiring and lamps should not be placed in direct contact with combustible materials. Makeshift hangers such as nails which might damage wiring insulation should not be used. Substantial wire guards should be installed on all lights subject to physical damage.

29. Stability—Fire Fighting.

(a) In the event of a fire due discretion should be used in the discharge of water into any under-deck compartment of a vessel, particularly the shelter decks or between decks. Measures to prevent overturning should be taken to the extent practicable when conditions indicate a threatening loss of stability.

(b) In locations where carbon dioxide gas is readily available in adequate quantities, this medium of extinguishment should preferably be employed in order that the vessel's stability be not endangered. Otherwise, if water is used, the vessel's pumping facilities should be in condition and ready to free the bilges of water wherever it tends to accumulate, in which connection it is important that all scuppers leading from all decks below main deck to the bilge be maintained free and open.

(c) Where more than one vessel is berthed at the same pier or in the same wet basin, provision should be made for the withdrawal of any vessel in the event that fire makes such withdrawal necessary.

Extract from *"Standards for the Control of Gas Hazards on Vessels to be Repaired"*

TABLE I

Permissible Concentrations for Exposure Not Exceeding a Total of 8 Hours Per Day.

Item	†Number of Parts per 1,000,000 Parts of Air	Corresponding Percent by Volume in Air
Aromatic Hydrocarbons:		
Benzene (Benzol)	100(a)	.01
Toluene (Toluol)	200(a)	.02
Xylene (Xylol)	200(a)	.02
Paraffinic Hydrocarbons:		
Normal Petroleum Gases	1000(b)	.10

The values indicated as (a) are standard toxicity limits of the American Standards Association. The values indicated as (b), half the usually accepted limit, are those adopted by the Marine Gas Chemists' Association.

PART III.

VESSELS DURING LAY-UP.

30. The following recommendations are intended for application with respect to vessels laid up for indefinite periods without personnel resident aboard.

31. Lay-Up Berth.

(a) Where the lay-up berth is contiguous to a wharf, pier or other land connected structure, it should be free from exposure to potential fire and explosion hazards, easy of access for fire fighting equipment, and within convenient proximity of adequate fire fighting facilities and water supply therefor. It should have sufficient depth of water at all stages of the tide to permit removal of the vessel in the event of fire.

(b) The wharf or pier should be in good repair and provided with adequate means for the safe mooring of vessels. Piers and wharves constructed and protected in accordance with the standards of the National Fire Protection Association* are recommended for vessel lay-up.

(c) A fire alarm box, telephone, or other reliable means of communication should be conveniently available and readily accessible.

(d) Vessels laid up in such numbers as to constitute a fleet should be separated in small groups to reduce the danger of fire spread. The degree of separation of vessels or groups thereof should be determined by the size of the vessels, the character of their construction as to combustible materials, and the prevailing winds at the site of lay-up.

(e) Mooring of vessels, whether singly or in groups, should be effected in such manner as to facilitate their quick removal in the event of fire.

(f) Where vessels are to be laid up some distance from shore facilities, *e.g.,* at anchor, the site should be chosen with due regard to the availability of adequate fire fighting forces and equipment, and arrangements should be made in advance for obtaining prompt response of such facilities in case of need.

32. Ground Tackle.

(a) A vessel in lay-up should have both anchors available for use.

(b) The windlass should be in operating condition. If power for operation of the windlass by the vessel's machinery is precluded or impracticable, temporary or emergency sources of power should be made available.

33. General Care and Cleanliness.

(a) Vessels in lay-up should be kept thoroughly clean throughout. All accumulations, particularly combustible rubbish, refuse and waste materials should be collected promptly and disposed of safely.

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*See *Recommended Good Practice for the Construction and Protection of Piers and Wharves.* National Fire Protection Assn. National Fire Codes, Vol. III, pages 408-430. Also available from National Board of Fire Underwriters as Pamphlet No. 87.